IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:	KYRLIDIS et al.	)	Examiner:	Arun S. Phasge
Application No.:	09/654,182	)	Group Art Unit:	1753
Filed:	September 1, 2000	)	Confirmation No.:	6449
Docket No.:	96074CIP (3600-011-02)	)		

For: CHROMATOGRAPHY AND OTHER ADSORPTIONS USING MODIFIED CARBON ADSORBENTS

APPEAL BRIEF UNDER 37 C.F.R. § 41

Mail Stop **Appeal Brief — Patents**
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

(1) Identification

The appellants, application, and the Examiner's identification data associated with this paper are provided in the above-captioned heading.

Appellant hereby files an Appeal Brief under 37 C.F.R. §41.37, together with the applicable fee under 37 C.F.R. §41.20(b)(2), the period for submitting this Appeal Brief having been extended five months from May 30, 2007 to October 30, 2007 by a concurrently filed Petition for Extension of Time under 37 C.F.R. § 1.136(a).

A Notice of Appeal under 37 C.F.R. §41.31 was previously filed with the applicable fee under 41.20(b)(1) on March 30, 2007, the period of response to which had been extended one month from February 28, 2007 to March 30, 2007 by a concurrently filed Petition for Extension of Time under 37 C.F.R. § 1.136(a).

(2) Table of Contents

(3) Real Party in Interest

The real party in interest in this case is *Cabot Corporation.*

(4) Related Appeals and Interferences

The appellants are not aware of any other appeals or interferences that will directly affect, be directly affected by, or have a bearing on the Board's decision in the present appeal.

(5) Status of Claims

Claims 11-15 are canceled.

Claims 1-10 and 16-29 are rejected. Claims 30-49 are not currently rejected.

No claim is withdrawn.

Claims 1-10 and 16-49 are on appeal.

(6) Status of Amendments

No amendment was filed subsequent to final rejection.

(7) Summary of Claimed Subject Matter

I. Concise Explanation of the Subject Matter Defined in Independent Claims and Separately Argued Dependent Claims

a) Independent Claim 1

Independent claim 1 is directed to a chromatography column comprising a column having a stationary phase and a mobile phase (page 4, lines 23-24; page 7, lines 14-15), wherein the stationary phase comprises carbonaceous material having attached at least one organic group (page 4, lines 24-25; page 7, lines 9-11), and wherein the carbonaceous material is particles having a size of from about 1 micron to about 500 microns (page 8, lines 11-13).

b) Dependent Claim 2

Dependent claim 2, which depends from claim 1 on appeal, further specifies that the organic group comprises at least one aromatic group directly attached onto the carbonaceous material (page 20, lines 2-3, 21-22; page 22, lines 4-7, 13-16).

c) Dependent Claim 3

Dependent claim 3, which depends from claim 1 on appeal, further specifies that the organic group comprises at least one alkyl group directly attached onto the carbonaceous material (page 20, lines 2-3; page 22, lines 4-7, 13-16).

d) Independent Claim 5

Independent claim 5 is directed to a separation device comprising a mobile phase and a stationary phase (page 7, lines 8-15), wherein the stationary phase comprises carbonaceous material having attached at least one organic group (page 5, lines 15-17; page 7, lines 9-10), and wherein the carbonaceous material is particles having a size of from about 1 micron to about 500 microns (page 8, lines 11-13).

e) Independent Claim 6

Independent claim 6 is directed to a method for conducting separation of chemical species from a substance comprising passing the substance through a system containing a mobile phase and a stationary phase (page 5, lines 3-5), wherein the stationary phase comprises carbonaceous material having attached at least one organic group (page 5, lines 5-6), and wherein the carbonaceous material is particles having a size of from about 1 micron to about 500 microns (page 8, lines 11-13).

f) Dependent Claim 8

Dependent claim 8, which depends from claim 6 on appeal, further recites that the separation is size exclusion chromatography (page 5, lines 6-7; page 7, line 23).

g) Dependent Claim 10

Dependent claim 10, which depends from claim 6 on appeal, further recites that the separation is adsorption-desorption chromatography (page 5, lines 6-7; page 8, line 1).

h) Dependent Claim 16

Dependent claim 16, which depends from claim 1 on appeal, further specifies that the organic group is a phenyl or naphthyl group having ionic or ionizable groups (page 19, lines 14-22; page 20, lines 4-15; page 22, lines 4-6; page 28, lines 3-5).

i) Dependent Claim 17

Dependent claim 17, which depends from claim 1 on appeal, further specifies that the organic group comprises an amino acid or derivatized amino acid, cyclodextrin, immobilized protein, polypeptides, or combinations thereof (page 25, lines 6-8, 22-23).

j) Dependent Claim 18

Dependent claim 18, which depends from claim 1 on appeal, further specifies the organic

group comprises a $-C_6F_5$ group, a trifluoromethyl-phenyl group, a bis-trifluorophenyl group, or combinations thereof (page 25, lines 8-10).

k) Dependent Claim 19

Dependent claim 19, which depends from claim 1 on appeal, further specifies the organic group comprises $-Ar-(C_nH_{2n+1})_x$ group, wherein n is an integer of from about 1 to about 30 and x is an integer of from about 1 to about 3 (page 25, lines 13-15).

l) Dependent Claim 20

Dependent claim 20, which depends from claim 1 on appeal, further specifies the organic group comprises cyclodextrin attached through an alkyl group (page 25, lines 20-21).

m) Dependent Claim 21

Dependent claim 21, which depends from claim 1 on appeal, further specifies the organic group comprises polyethylene glycol or methoxy-terminated polyethylene glycol or derivatized resins thereof (page 26, lines 1-2).

n) Dependent Claim 22

Dependent claim 22, which depends from claim 1 on appeal, further specifies the organic group comprises $-Ar-((C_nH_{2n})COOX)_m$, wherein Ar is an aromatic group, n is 0 to 20, m is 1 to 3, and X is H, a cation, or an organic group (page 23, lines 11-15).

o) Dependent Claim 23

Dependent claim 23, which depends from claim 1 on appeal, further specifies the organic group comprises $Ar-((C_nH_{2n})OH)_m$, wherein Ar is an aromatic group, n is 0 to 20, m is 1 to 3 (page 23, lines 16-19).

p) Dependent Claim 24

Dependent claim 24, which depends from claim 1 on appeal, further specifies the organic group comprises $-Ar-((C_nH_{2n})NH_2)_m$, wherein n is 0 to 20, m is 1 to 3, or its protonated form: $-Ar-((C_nH_{2n})NH_3X)_m$, wherein X is an ion, and Ar is an aromatic group (page 23, lines 20-21).

q) Dependent Claim 25

Dependent claim 25, which depends from claim 1 on appeal, further specifies the organic group comprises $Ar-((C_nH_{2n})CHNH_3^+COO^-)_m$ and the reaction products thereof with molecules containing functional groups terminated in $-NH_2$, -OH, or -COOH, wherein Ar is an aromatic group and n is 0 to 20 (page 24, lines 1-5).

r) Dependent Claim 26

Dependent claim 26, which depends from claim 1 on appeal, further specifies the organic group comprises $-Ar-((C_nH_{2n})CH=CH_2)_m$, wherein n is 0 to 20, m is 1 to 3 or $-Ar-((C_nH_{2n})SO_2CH=CH_2)_m$, where n is 0 to 20 and m is 1 to 3 (page 24, lines 6-10).

s) Dependent Claim 27

Dependent claim 27, which depends from claim 1 on appeal, further specifies the organic group comprises at least one chiral ligand group (page 25, lines 22-24).

(8) Grounds of Rejection to be Reviewed on Appeal

1) Whether claims 1-7 and 9 are unpatentable under 35 U.S.C. §103(a) as being obvious over Stalling et al. (U.S. Patent No. 5,308,481) in view of Japanese Patent 04-346830 (Japanese '830) (Abstract only).

2) Whether claim 17 is unpatentable under 35 U.S.C. §103(a) as being obvious over U.S. Patent No. 5,308,481 to Stalling et al. in view of Japanese Patent 04-346830, as applied to claims 1-7 and 9, and further in view of Kusano et al. (EP 0 300 448).

3) Whether claims 8, 10, 16 and 18-29 are unpatentable under 35 U.S.C. §103(a) as being obvious over U.S. Patent No. 5,308,481 to Stalling et al. in view of Japanese Patent No. 04-346830, as applied to claims 1-7 and 9, and further in view of Boes et al. (U.S. Patent No. 5,807,494).[1]

[1] The Final Office Action of November 30, 2006 indicates that this rejection is applicable to claims 8, 10, 16, and 18-29. Presumably, claims 30-49 are allowable subject matter.

(9) Argument

1. Rejection Under 35 U.S.C. § 103(a) Over Stalling (U.S. Patent No. 5,308,481) in view of Japanese Patent 04-346830 (Japanese '830)

Claim 1

Claims 1-7 and 9 were finally rejected under 35 U.S.C. §103(a) as being obvious over U.S. Patent No. 5,308,481 to Stalling et al. in view of Japanese Patent 04-346830 (Japanese '830) (Abstract only).

The Examiner's Position

According to the Final Office Action (page 2), these claims are unpatentable over Stalling et al. in view of Japanese '830 for the following reasons:

> The Stalling patent only discloses the use of fullerenes, which are carbon molecules smaller than the claimed range. The '830 patent teaches the use of carbon particles including the claimed range having attached organic molecules used as packing for a chromatography column (see abstract).
>
> Accordingly, the invention as a whole would have been obvious to one having ordinary skill in the art at the time the invention was made to use bigger sized carbon molecules in place of the fullerenes taught by the Stalling patent, because the Japanese patent teaches that bigger carbon molecules can be used to present additional benefits with the use of said porous carbon.

The Examiner also added the following remarks in the Final Office Action (page 3) in support of the rejection:

> Applicants further argue that the Stalling patent does not describe the attachment of the aromatic portion of the defined group be attached to the carbonaceous material. The specification does not recite that the aromatic portion of the defined group is attached to the carbonaceous material. Therefore, the figure 10B shows just such attachment, since the aromatic portion is attached to said carbonaceous material.
>
> The use of crosslinking agents would read upon the claims, in particular since the formation of the polymer particle attached

to a carbonaceous particle would read upon the claims.

Following an interview conducted on March 6, 2007 between the Examiner and a representative of the appellants, an Interview Summary was mailed with an office communication dated March 6, 2007, which provided the following comments on the interview:

> discussed the differences between the fullerene of Stalling and the carbon particle claimed. Also the chemical attachment of the organic group.

For the following reasons, Appellants request review and reversal of this rejection.

The Appellants' Position

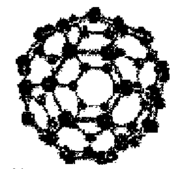
A new class of adsorbents and new separation devices which make use of a particular type of carbon materials are provided in the present application. Independent claim 1 on appeal is directed to a chromatography column comprising a mobile phase and a stationary phase, wherein the stationary phase comprises carbonaceous material having attached at least one organic group. The carbonaceous material is particles having a size of from about 1 micron to about 500 microns.

In chromatography and other separation methods, there is a certain amount of selectivity that is necessary in order for the stationary phase to separate the various components in a mixture. For this reason, conventional carbon products such as carbon black, graphite and activated carbon have not been used as a standard stationary phase in certain separation systems because carbon *per se* is a strong non-specific adsorbent (page 3, lines 16-20). In the separation devices of the present application, such as recited in claim 1 on appeal, at least one organic group is attached to a stationary phase carbonaceous material that affects the adsorbent capacity and selectivity of the carbonaceous material in a useful manner (page 9, line 20 to page 10, line 1; page 12, lines 14-17). In practicing the present invention, once a desired separation technique is chosen and the particular

chemical species known, a particular functional group or multiple functional groups can be chosen to be attached onto the carbonaceous material. The carbonaceous material therefore can be tailored to be selective to the targeted chemical species to suit the separation needed. Another benefit is that the organic group is not easily removed from the surface of the carbonaceous material to which it is attached, unlike, for example, physically deposited coating materials. The carbonaceous material having the attached organic group not only is selective but also provides a durable resilient stationary phase that is resistant to corrosion, swelling, sterilization chemicals, and/or extreme temperatures and pressures, and also is stable at a wide pH range (page 13, lines 1-4).

Stalling et al. shows conventional resin and silica supports being used as the stationary phases, wherein very small diameter fullerenes are attached onto the resin and silica supports using reactive groups. At the above-mentioned interview conducted with the Examiner on March 6, 2007, the appellants' representative explained that the "substrates" of the present invention, such as recited in claim 1, are about 1-500 micron size carbon particles to which discrete organic groups are directly attached, while Stalling describes an opposite scenario where a polymeric resin or siliceous matrix serves as the substrate to smaller 7-9 Ångstrom size fullerenes. As shown in Figure 1A of Stalling et al., the size of the resin or silica support is shown as 1.9 microns, and the attachment of the fullerene would be significantly smaller than this resin or silica support as shown in Figure 1C. As shown in the record before the Examiner at the time of the final rejection, Fullerene C_{60} and Fullerene C_{70} have a size of 7 - 9 Å diameter, which is significantly smaller than 1 micron. A portion of the product information on the fullerene made by the company used in Stalling et al. is set forth below and was submitted in the Amendment filed September 15, 2006.

MER Fullerene Products

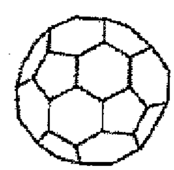


Item: Fullerene Soot
Catalog# MRST
Description: As-produced carbon soot prepared by the Kraetschmer-Huffman arc process. MER fullerene soot is guaranteed to yield over 7 wt% fullerenes when extracted with toluene. Typical composition of the extract is 75% C_{60}, 22% C_{70}, 3% higher-order fullerenes. The particle size of the soot is 0.02 to 10 microns. Powder density is about 0.05 grams/cc.

Prices for As-produced Fullerene Soot, Catalog# MRST.
Up to 100 grams $3.00 per gram
Over 100 grams $2.00 per gram

Item: Fullerene C_{60}, 99+%
Catalog# MR6LP
Description: Over 99% pure C_{60} produced by chromatography. The product is a dark brown powder with powder densitiy of about 0.8 g/cc. Impurities include C_{70} and C_{60} oxides. The material may also contain up to 0.2% adsorbed solvent.

7 Å diameter



C_{60}

Prices
1-10 grams $40.00 per gram
11-50 grams $30.00 per gram
51-100 grams $25.00 per gram
over 100 grams $20.00 per gram

This would make sense because the fullerene would have to be significantly smaller than the size of the resin or silica support to which it is being ultimately attached to. Stalling et al. does not teach carbonaceous particles having a size of 1 to 500 microns, nor as used as a stationary phase to which is attached at least one organic group as presently recited. In addition, as explained in the background section of the present application, silica materials are only stable in a narrower pH range of 1-8, and silica columns can not be used in column sterilization procedures using hot sodium hydroxide (page 3, line 23; page 4, lines 3-6). Therefore, the silica supports of Stalling et al. would be predicted and expected to suffer from these disadvantages, which are avoided in the present invention due to use of carbon particle substrates instead of silica.

With respect to the above-mentioned reference made to crosslinking agents in the Final

Office Action (at page 3), the passage at col. 9, lines 10 - 21 of Stalling et al. refers to glycol dimethacrylate, triethyleneglycol dimethacrylate and tetraethyleneglycol dimethacrylate as crosslinking agents that are combined with monomers in the formation of a core-shell polymer particle, which is one of the support (or substrate) particles mentioned in the Stalling et al. reference. This particular passage of Stalling et al. has nothing to do with fullerenes, but rather relates to the formation of a specific type of substrate to which a fullerene is attached to.

The secondary reference of Japanese '830 does not cure these deficiencies of the principal reference of Stalling et al. In particular, the Examiner's alleged modification of Stalling et al. in view of Japanese '830 simply would not work since one having skill in the art would have to replace fullerene having a small molecule with a large porous carbon fine particle and then somehow attach that to a polymer particle. The fullerene in Stalling et al. is the material attached to the substrate, whereas the large porous carbon fine particle of Japanese '830 is the substrate/support. The basis for rejection does not substitute for support for another, but in essence, is attaching the support of Stalling et al. to the support of Japanese '830. This would not make sense in the field of chromatography or using the "common sense" promoted in *KSR Int'l Co. v. Teleflex, Inc.*

Unlike the claimed invention, Japanese '830 describes a porous carbon fine particle that is modified with a *coating* material, such as protein A or polyethylene "glycohol" (Abstract). The English abstract of Japanese '830 indicates that the average particle size of the carbon particles is 0.5 to 100 μm (*i.e.*, 5,000 Å to 1,000,000 Å). Japanese '830 does not teach attaching the "bigger sized" carbon particles to a polymer particle or siliceous support. At most, Japanese '830 teaches particles as big as 1,000,000 Å size can be replaced for particles as small as 5,000 Å size *as substrates for receiving a physical coating of polyethylene glycol*. Contrary to what the Examiner

suggests in the final rejection, Japanese '830 does not teach or suggest that the bigger sized carbon particles of 5,000 Å to 1,000,000 Å size can be substituted for (7-9 Å) fullerenes in other applications, nor indicate what advantages might be achieved from such modifications. Such a proposal by the Examiner, in effect, requires replacement of "BB's" (*i.e.*, Stalling's fullerenes) with "bowling balls" (*i.e.*, Japanese '830's carbon particles). It would not have been possible to predict if the resin or silica supports of Stalling et al. would still function in their known or intended manner if such a dramatic change were attempted in the carbon particle sizes used in Stalling et al.

Furthermore, the Examiner's proposed modification of Stalling et al. would appear to undercut a stated objective of Stalling et al. of fixing buckminsterfullerenes onto siliceous or polymer particles in order to create *a lattice structure* that is especially useful as a chromatographic support particle (col. 4, lines 30-40; col. 4, line 50 to col. 5, line 15). The Stalling et al. reference teaches that those inventors had solved a problem encountered in conventional chromatographic fractionation of certain components using conventional activated charcoal and other conventional adsorbents by instead using the *fullerene-based*, copolymer and inorganic media described therein (*e.g.*, see col. 2, lines 5-21, 59-61; col. 3, lines 8-18; col. 4, lines 30-33). In particular, Stalling et al. teaches a fullerene-based lattice structure for solving the problems associated with conventional chromatographic adsorbents such as activated charcoal. Stalling et al. shed light on the criticality of their fullerene-based solution to such conventional problems by the following comments: "*The added uniformity and ordered structure of the carbon fullerene-as opposed to amorphous carbon graphite- may open avenues for developing even more powerful adsorbent, filtration, and chromatography matrices based on carbon*" (col. 1, lines 53-61). This explains why the problem-solution focus of Stalling et al. is on how to attach *fullerenes* to a support to form an insoluble

matrix in order to provide a stable chromatographic phase (col. 1, lines 58-61). *Recourse to common sense* suggests that a person of ordinary skill in the art at the time of the invention would not have reasonably looked to Japanese '830 to solve a problem already solved by Stalling et al. *KSR Int'l Co. v. Teleflex Inc.*, 127 S.Ct. 1727, 1740-41, 82 USPQ2d 1385, 1396 (2007). Nor would one of ordinary skill in the art having common sense at the time of the invention be expected to tamper with Stalling et al.'s required lattice structure made with fullerenes by trying to substitute in much bigger sized carbon particles of Japanese '830. Nor would it be common sense to replace the attached material of Stalling et al. for a substrate of Japanese '830 in order to have a substrate-substrate material.

One of ordinary skill in the art also would also understand that the particle coating disclosed in Japanese '830 is material that *physically* covers at least a portion of the carbon particles. As can be appreciated, Japanese '830 fails to teach or suggest a carbonaceous material having at least one organic group attached to the carbonaceous material. As explained in the background section of the present application, prior attempts to modify surfaces of carbonaceous materials by surface modification by physical means, and, in particular, by depositing a species on the surface of the carbonaceous material, which is also what Japanese '830 describes, have had limited utility because the deposited layer is easily removed (page 2, lines 5-12). The physically coated carbon particles described by Japanese '830 would be expected to suffer from a similar disadvantage.

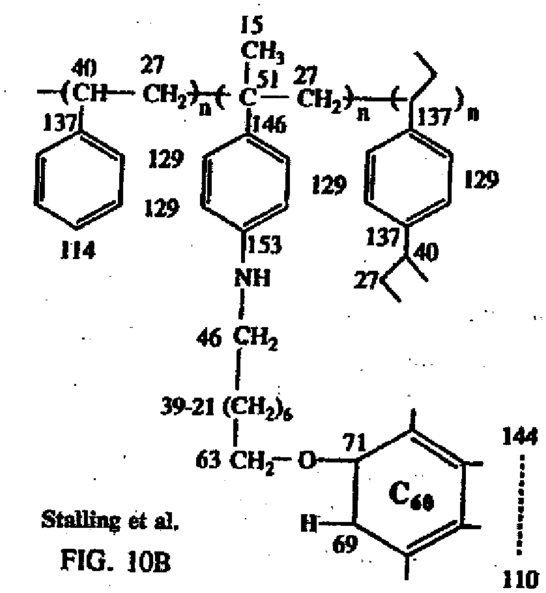
As can be appreciated, neither Stalling et al. nor Japanese '830 teach any organic groups attached to a carbonaceous material having a particle size of from about 1 micron to about 500 microns as required by independent claim 1 on appeal.

In view of at least the above reasons, this rejection of claim 1 on appeal should be reversed.

Claim 2

Claim 2 on appeal requires that the organic group comprises at least one aromatic group directly attached onto the carbonaceous material.

As indicated above, the Final Office Action (page 3) alleges that figure 10B of Stalling et al. is relevant to this feature. Stalling et al. contains no teaching or suggestion of a carbonaceous material having an aromatic group *directly* attached onto the carbonaceous material. Nor is possible to predict from the prior art what the outcome of such a drastic modification might be. The linkage shown in Fig. 10B of Stalling et al., which reproduced below, is a <u>$-CH_2-(CH_2)_6-CH_2-$ chain</u> joined at one end to <u>an oxygen atom</u> bonded to a fullerene (*i.e.*, the C_{60} portion), and joined at the other end to an <u>NH group</u> of a polystyrene-NH_2 polymer particle.



Stalling et al.
FIG. 10B

During said interview conducted with the Examiner on March 6, 2007, the appellants' representative referred the Examiner to FIG. 10B of Stalling and requested clarification on where "an aromatic portion" of the resin support is attached directly to the fullerene according to the

Examiner's position of record. In reply to this question, the Examiner stated at the interview that the PTO was taking the position that the entire moiety shown in FIG. 10B of Stalling, excluding the fullerene (i.e., the C_{60} portion), is an "aromatic group" because it includes an aromatic structure.

Contrary to the Examiner's suggestion made in the Final Office Action and during said interview of March 6, 2007, Figure 10B of Stalling et al., as reproduced above, does not disclose attachment of an aromatic portion to carbonaceous material as presently claimed.

The appellants respectfully disagree that the FIG. 10B structure shown by Stalling et al. can be properly interpreted in the manner proposed by the Examiner. A polymeric resin support as taught by Stalling et al. would not be reasonably interpreted by persons skilled in the art as meaning "an organic group", nor particularly one directly attached to a carbon particle. By analogy, where a floating dock is attached to an island where the shore line meets a body of water, common sense informs that one does not ordinarily refer to the land mass ("resin support") as being attached to the floating dock ("fullerene").

However, even assuming the entire moiety shown in FIG. 10B of Stalling, excluding the fullerene (i.e., the C_{60} portion), is an "aromatic group", as proposed by the Examiner, and for sake of argument only here, that theory still fails to account for Stalling et al.'s requirement that the "carbonaceous material" in the structure is 7 - 9 Å diameter size particles. Stalling et al. specifically indicates that the fullerene serves particular purposes when attached to the porous polymer support particles (*e.g.*, see col. 4, line 64 to col. 5, line 15; col. 5, lines 60-62). Therefore, the Examiner has not explained how fullerene could be replaced by "porous carbon fine particles" having a much larger size, *i.e.*, large carbon particles different than angstrom-sized fullerenes.

The Final Office Action does not suggest how Japanese '830 may compensate for this difference between claim 2 on appeal and Stalling et al. The appellants submit that Japanese '830 can not make up for this difference as Japanese '830 teaches coating polyethylene glycol on carbon particles, and not an organic group having an aromatic group directly attached to a carbonaceous material.

Claim 2 on appeal also is not obvious over Stalling et al. and Japanese '830 for the same reasons as explained above by the appellants in reference to its parent claim 1 on appeal, and reference is made thereto.

In view of at least the above reasons, this rejection of claim 2 on appeal should be reversed.

Claim 3

Claim 3 on appeal requires that the organic group comprises at least one alkyl group directly attached onto the carbonaceous material.

As explained above in connection with claim 2 on appeal, the linkage shown in Fig. 10B of Stalling et al. is a $-CH_2-(CH_2)_6-CH_2-$ chain joined at one end to <u>an oxygen atom</u> bonded to a fullerene and joined at the other end to an NH group of a polystyrene-NH_2 polymer particle. An oxygen atom is not an alkyl group, and *vice versa*. Therefore, Stalling et al. fails to teach or suggest a carbonaceous material having an alkyl group *directly* attached onto the carbonaceous material. The appellants submit that Japanese '830 can not make up for this difference for the same reason explained above in connection with claim 2 on appeal, and reference is made thereto.

In view of at least the above reasons, this rejection of claim 3 on appeal should be reversed.

Claim 6

Independent claim 6 on appeal is directed to a method for conducting separation of chemical

species from a substance comprising passing the substance through a system containing a mobile phase and a stationary phase, wherein the stationary phase comprises carbonaceous material having attached at least one organic group, and wherein the carbonaceous material is particles having a size of from about 1 micron to about 500 microns.

Stalling et al. teaches a method of column chromatography fractionation that requires use of a packing media formed of fullerenes covalently bonded to a polymer particle or a siliceous support particle. Stalling et al. declares victory over problems associated with conventional chromatographic usages of conventional amorphous carbon and activated charcoal by their fullerene-based, copolymer and inorganic packing media (e.g., see col. 2, lines 5-21, 59-61; col. 3, lines 8-18; col. 4, lines 30-33). The proposed substitution in the Examiner's final rejection of claim 6 on appeal of the bigger carbon particles of Japanese '830 for the fullerenes taught by Stalling et al. is not a predictable use of these respective prior art elements according to their established functions. If anything, it is an unpredictable use of them because it goes against the teachings and objectives of the primary reference.

In view of at least the above reasons, this rejection of claim 6 on appeal should be reversed.

Rejection of claim 17 under 35 U.S.C. §103(a) over Stalling et al. in view of Japanese '830 as applied to Claims 1-7 and 9, and further in view of Kusano et al.

Claim 17 was finally rejected under 35 U.S.C. §103(a) as being obvious over U.S. Patent No. 5,308,481 to Stalling et al. in view of Japanese Patent 04-346830 (Japanese '830), as applied to claims 1-7 and 9, and further in view of Kusano et al. (EP 0 300 448).

Claim 17

The Examiner's Position

According to the Final Office Action (page 2), these claims are unpatentable over Stalling

et al. in view of Japanese '830 and Kusano et al. for the reasons of record. In the Office Action dated June 15, 2006 (page 3), the following reasons were set forth in this respect:

> The Stalling patent does not disclose that the organic molecule that is attached to the carbonaceous material is an amino type molecule as claimed. The Kusano reference is cited to show the use of the claimed amino type molecule used as a separation medium (see Abstract).
>
> Consequently, the invention as a whole would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the disclosure of the Stalling patent with the teachings of the Kusano reference, because the Kusano reference teaches that the use of amino type molecules allows the use of said molecules as separation medium in chromatography.

The Examiner also added the following remarks in the Final Office Action (pages 3-4) in support of the rejection:

> With regard to the combination of the Kusano patent with the Stalling patent, applicants argue that the Kusano patent does not disclose the attachment onto anything, rather is merely discloses the coating onto the substrate. As disclosed in the Japanese patent the coating of the carbon particles with organic materials would amount to attachment within the meaning of the claims. To use a different material, such as the amino acid derivative taught by the Kusano patent, would have been obvious to one having ordinary skill in the art at the time the invention was made, because such coating provides an "attachment" of the organic material onto the substrate.

For the following reasons, Appellants request review and reversal of this rejection.

The Appellants' Position

As discussed above, Stalling et al. attaches a very small diameter fullerene onto a conventional resin or silica support. Stalling et al. does not teach or suggest any modification of fullerenes with organic groups that affect the selectivity of a chromatographic material and there is no indication that it would even be possible to make a stable modification of this type to a

fullerene. Kusano et al. does not overcome the deficiencies of Stalling et al. In particular, Kusano et al. describes the use of a coating of an optically active amino acid derivative on a substrate to provide a separation medium for separating racemic mixtures. Kusano et al. does not teach any attachment of its amino acid derivatives to anything, but rather only describes coating the amino acid derivatives onto a substrate. Kusano et al. does not teach or suggest an organic group that comprises cyclodextrin in particular. Further, it is not possible to predict from the teachings of Stalling et al. or Kusano et al., either singly or combined, that the amino acid derivatives of Kusano et al. could be replaced with cyclodextrin, nor that the latter would be capable of performing the function of facilitating the attachment of fullerenes to polymer particles to form a lattice structure.

Also, if Stalling et al. was somehow combinable with Kusano et al., one skilled in the art would only be motivated to remove the fullerene and attach an amino acid onto the conventional resin or silica substrate of Stalling et al. This would clearly be different from the claimed invention since the claimed invention is using the carbonaceous material as the "substrate" to attach organic groups onto. There is no teaching or suggestion in Stalling et al. or Kusano et al., either singly or combined, that the amino acid derivatives of Kusano et al. would be capable of performing the function of facilitating the attachment of fullerenes to polymer particles to form a lattice structure, or even that the amino acid derivatives of Kusano et al. could be attached to fullerenes at all. Kusano et al. does not teach any attachment of its amino acid derivatives to anything, but rather only describes coating the amino acid derivatives onto a substrate.

Accordingly, Stalling et al., Japanese '830 and Kusano et al., either singly or combined, do not teach or suggest or predict functional success for a separation device comprising a mobile

phase and a stationary phase, wherein the stationary phase comprises carbonaceous material having attached cyclodextrin, as required by claim 17.

In view of at least the above reasons, this rejection of claim 17 on appeal should be reversed.

Rejection of claims 8, 10, 16 and 18-29 under 35 U.S.C. §103(a) over Stalling et al. in view of Japanese '830 as applied to the claims above and further in view of Boes et al.

Claims 8, 10, 16 and 18-29 were finally rejected under 35 U.S.C. §103(a) as being obvious over Stalling et al. in view of Boes et al. (U.S. Patent No. 5,807,494).

The Examiner's Position

According to the Final Office Action (page 3), claims 8, 10, 16 and 18-29 are unpatentable over the Stalling in view of Japanese '830 and Boes et al. for the reasons of record. In the Office Action dated June 15, 2006 (page 4), the following reasons were set forth in a rejection not involving Japanese '830:

> The Stalling patent does not disclose the specific types of chromatography nor does the Stalling patent disclose the other types of organic molecules that can be attached to the carbonaceous material as claimed.
>
> The Boes patent is cited to show the use of a variety of organic groups that are attached to the carbonaceous material, which includes the claimed organic groups (see col. 4, line 25 to col. 5, line 22).
>
> Consequently, the invention as a whole would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the disclosure of the Stalling patent with the teachings of the Boes patent, because the Boes patent teaches that the use of the other types of organic molecules that can be attached to carbonaceous material. Furthermore, any similar chromatography would be an obvious use of the materials disclosed by Stalling.

The Examiner also added the following remarks in the Final Office Action (page 4)

in support of the rejection:

> With regard to the combination of the Boes with the Stalling patent, applicants argue that the Stalling patent uses the organic groups to attach the fullerenes to the polymer or siliceous particles.
>
> The Stalling patent teaches that different attachments of the organic compounds to the fullerenes affects the chromatographic separation of the obtained separation medium and are not there merely for the formation of a lattice structure (see col. 4, line 50 to col. 5, line 28). The secondary references are cited to show the use of other organic compounds attached to carbonaceous material.
>
> It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the disclosure of the Stalling patent with the teachings contained in the Boes patent, because the secondary reference teaches other organic groups attached to carbonaceous material.

For the following reasons, Appellants request review and reversal of this rejection.

The Appellants' Position

Claim 8

Dependent claim 8 on appeal further recites that the separation recited in the method of claim 6 on appeal is size exclusion chromatography.

The Examiner's comment of record in the (non-final) Office Action dated June 15, 2006, at page 4, that "... any similar chromatography would be an obvious use of the materials disclosed by Stalling" is conclusory in nature. How is "similar" being defined in this regard? The Final Office Action also ostensibly relies at least in part on the Boes et al. reference in finally rejecting claim 8 on appeal since claim 8 was not rejected based on Stalling et al. alone. However, the Final Office Action does not provide any analysis that articulates some reasoning or analysis with some rationale underpinning to support a legal conclusion of obviousness against claim 8. This analysis should be made explicit. *KSR Int'l Co. v. Teleflex Inc.*, 127 S.Ct. 1727, 1740-41, 82 USPQ2d

1385, 1396 (2007)(internal cite omitted). For instance, there is an absence in the Final Office Action of an "... identified reason that would have prompted a person of ordinary skill in the relevant field to combine the elements in the way the claimed invention does" *Id.*, 127 S.Ct. at 1741, 82 USPQ2d at 1396. Therefore, there is insufficient analysis set forth by the Examiner in the Final Office Action to support a *prima face* case of obviousness against claim 8 on appeal.

The appellants further observe that Stalling et al. teaches that the polymer and the siliceous supports function as the molecular size exclusion component while the bound fullerenes display chromatographic effects (col. 5, lines 34-64; col. 6, lines 3-7). By contrast, present claim 8 on appeal recites a method using modified carbonaceous material capable of size exclusion performance, and not the use of an unrecited component such as a silica support for that function. This is a significant difference between Stalling et al. and present claim 8. Boes et al. does not cure this deficiency of the primary reference.

Boes et al. describes carbon blacks that are attached to a metal oxide gel component (Abstract). The Final Office Action does not explain a reason for why one of ordinary skill at the time of the invention would have considered modifying the packing media of Stalling et al. *and* then using the modified packing media in size exclusion chromatography, based on anything taught by Boes et al.

In view of at least the above reasons, this rejection of claim 8 on appeal should be reversed.

Claim 10

Dependent claim 10 on appeal further recites that the separation recited in the method of claim 6 on appeal is adsorption-desorption chromatography.

The Final Office Action ostensibly also makes further reference to the Boes et al. reference

relative to claim 10 on appeal, but does not provide any explicit analysis that articulates some reasoning or analysis to support a legal conclusion of obviousness against claim 10. Therefore, there is insufficient analysis set forth by the Examiner in the Final Office Action to support a *prima face* case of obviousness against claim 10 on appeal.

In view of at least the above reasons, this rejection of claim 10 on appeal should be reversed.

Claim 16

Claim 16 on appeal recites that the organic group is a phenyl or naphthyl group having ionic or ionizable groups.

As discussed above, Stalling et al. only describes reactive groups as being bonded onto fullerenes to facilitate the attachment of the fullerenes to an inorganic polymer or siliceous particle or the attachment of fullerenes to each other. Stalling et al. does not teach or suggest carbonaceous particles having a size of about 1 micron to 500 microns. As also discussed above, the chromatographic material of Stalling et al. is a lattice structure of joined fullerenes and polymer or siliceous particles. Therefore, Stalling et al. only describes groups such as $-CH_2X$, -OH, $-NH_2$ and -COOH that are capable of facilitating the formation of a lattice structure (*e.g.*, col. 4, lines 54-57).

Regarding the Examiner's reference to col. 4, line 50, to col. 5, line 28 of Stalling et al. at page 4 of the Final Office Action, the appellants respectfully disagree with the Examiner's assertion that Stalling et al. teaches that different attachments of the organic compounds to the fullerenes affect the chromatographic separation of the obtained separation medium and are not there merely for the formation of a lattice structure. This particular passage in Stalling et al. only indicates that certain reactive groups can be used to link the fullerenes to the polymer or silica

support. At col. 4, lines 64-66, for example, Stalling et al. clearly indicates that the reactive groups are used to form a lattice structure. At col. 5, lines 3-8, Stalling et al. indicates only that chromatography affinity is affected by the type of polymer particle, such as a co-polymer resin particle. These polymer particles that Stalling et al. refers to, are inorganic particles. No where does Stalling et al. teach or suggest or predict that different attachments of organic compounds to the fullerenes affect the chromatographic separation of the obtained separation medium.

The problems with combining Stalling et al. with Japanese '830 with respect to the rejection of claims 1-7 and 9 apply equally here.

Further, Boes et al. describes carbon black products that have an attached organic group substituted with an ionic or an ionizable group that provide the advantage of increased water dispersability (see, *e.g.*, col. 5, lines 23 - 37). Clearly, this objective of providing increased water dispersability is directly at odds to the objective in Stalling et al. of joining particles together into a lattice structure (col. 4, lines 30-40). There is no teaching or suggestion or prediction of success in Boes et al. of using organic groups to attach carbon black particles to anything else. Therefore, a person skilled in the art would have been lead away from considering modifying Stalling et al. with the teachings of Boes et al. Moreover, since Stalling et al. does not teach or suggest or predict any other use for reactive groups attached to the fullerenes except for providing the fixation of fullerenes and polymer or siliceous particles and since Boes et al. contains no disclosure relevant to chromatography at all, the advantages described in the present application of affecting the adsorption properties and the selectivity of a chromatographic material by attaching organic groups is not found in either reference, taken singly or combined. One skilled in the art would have had no reason to look to Boes et al. The carbon materials are different and the uses are different from

Stalling et al.

Accordingly, Stalling et al., Japanese '830, and Boes et al., either singly or combined, do not teach or suggest or predict a separation device comprising a mobile phase and a stationary phase, wherein the stationary phase comprises carbonaceous material having attached thereto the specific groups required by claim 16 on appeal.

In view of at least the above reasons, this rejection of claim 16 on appeal should be reversed.

Claim 18

Claim 18 on appeal recites that the organic group comprises a $-C_6F_5$ group, a trifluoromethyl-phenyl group, a bis-trifluorophenyl group, or combinations thereof.

The Examiner referenced the passage at col. 4, line 25 to col. 5, line 22 of Boes et al. as showing the use of a variety of organic groups attached to the carbonaceous materials. However, that passage of Boes et al. does not appear to teach any of the organic groups recited in claim 18. Further, the arguments above with respect to claim 16 apply equally here.

In view of at least the above reasons, this rejection of claim 18 on appeal should be reversed.

Claim 19

Dependent claim 19 on appeal further specifies the organic group comprises $-Ar-(C_nH_{2n+1})_x$ group, wherein n is an integer of from about 1 to about 30 and x is an integer of from about 1 to about 3.

The Examiner referenced the passage at col. 4, line 25 to col. 5, line 22 of Boes et al. as showing the use of a variety of organic groups attached to the carbonaceous materials. However, that

passage of Boes et al. does not appear to teach an organic group as recited in claim 19. Further, the arguments above with respect to claim 16 apply equally here.

In view of at least the above reasons, this rejection of claim 19 on appeal should be reversed.

Claim 20

Dependent claim 20 on appeal further specifies the organic group comprises cyclodextrin attached through an alkyl group.

The Examiner referenced the passage at col. 4, line 25 to col. 5, line 22 of Boes et al. as showing the use of a variety of organic groups attached to the carbonaceous materials. However, that passage of Boes et al. does not appear to teach an organic group as recited in claim 20. Further, the arguments above with respect to claim 16 apply equally here.

In view of at least the above reasons, this rejection of claim 20 on appeal should be reversed.

Claim 21

Dependent claim 21 on appeal further specifies the organic group comprises polyethylene glycol or methoxy-terminated polyethylene glycol or derivatized resins thereof.

The Examiner referenced the passage at col. 4, line 25 to col. 5, line 22 of Boes et al. as showing the use of a variety of organic groups attached to the carbonaceous materials. However, that passage of Boes et al. does not appear to teach an organic group as recited in claim 21.

Additionally, Example 2 of the present application (pages 33-34) describes unexpected results achieved in terms of successful promotion of non-specific adsorption of protein at the carbon

surface with carbon black modified by attaching methoxy-terminated polyethylene glycol groups onto the carbon black as compared to untreated or conventional carbon black.

Evidence that elements work together in an unexpected and fruitful manner supports a conclusion that the structure would not have been obvious to those skilled in the art. *KSR*, 127 S.Ct. at 1740, 82 USPQ2d at 1395. The appellants submit that Example 2 of the present application provides evidence that chromatography columns comprising a stationary phase comprising a carbonaceous material having attached an organic group comprising polyethylene glycol or methoxy-terminated polyethylene glycol or derivatized resins thereof perform in an unexpected and fruitful manner. Further, the arguments above with respect to claim 16 apply equally here.

In view of at least the above reasons, this rejection of claim 21 on appeal should be reversed.

Claim 22

Dependent claim 22 on appeal further specifies the organic group comprises $-Ar-((C_nH_{2n})COOX)_m$, wherein Ar is an aromatic group, n is 0 to 20, m is 1 to 3, and X is H, a cation, or an organic group.

The Examiner referenced the passage at col. 4, line 25 to col. 5, line 22 of Boes et al. as showing the use of a variety of organic groups attached to the carbonaceous materials. However, that passage of Boes et al. does not appear to teach an organic group as recited in claim 22. Further, the arguments above with respect to claim 16 apply equally here.

In view of at least the above reasons, this rejection of claim 22 on appeal should be reversed.

Claim 23

Dependent claim 23 on appeal further specifies the organic group comprises $Ar-((C_nH_{2n})OH)_m$, wherein Ar is an aromatic group, n is 0 to 20, m is 1 to 3.

The Examiner referenced the passage at col. 4, line 25 to col. 5, line 22 of Boes et al. as showing the use of a variety of organic groups attached to the carbonaceous materials. However, that passage of Boes et al. does not appear to teach an organic group as recited in claim 23. Further, the arguments above with respect to claim 16 apply equally here.

In view of at least the above reasons, this rejection of claim 23 on appeal should be reversed.

Claim 24

Dependent claim 24 on appeal further specifies the organic group comprises $-Ar-((C_nH_{2n})NH_2)_m$, wherein n is 0 to 20, m is 1 to 3, or its protonated form: $-Ar-((C_nH_{2n})NH_3X)_m$, wherein X is an ion, and Ar is an aromatic group.

The Examiner referenced the passage at col. 4, line 25 to col. 5, line 22 of Boes et al. as showing the use of a variety of organic groups attached to the carbonaceous materials. However, that passage of Boes et al. does not appear to teach an organic group as recited in claim 24. Further, the arguments above with respect to claim 16 apply equally here.

In view of at least the above reasons, this rejection of claim 24 on appeal should be reversed.

Claim 25

Dependent claim 25 on appeal further specifies the organic group comprises $Ar-((C_nH_{2n})CHNH_3^+COO^-)_m$ and the reaction products thereof with molecules containing

functional groups terminated in $-NH_2$, -OH, or -COOH, wherein Ar is an aromatic group and n is 0 to 20.

The Examiner referenced the passage at col. 4, line 25 to col. 5, line 22 of Boes et al. as showing the use of a variety of organic groups attached to the carbonaceous materials. However, that passage of Boes et al. does not appear to teach an organic group as recited in claim 25. Further, the arguments above with respect to claim 16 apply equally here.

In view of at least the above reasons, this rejection of claim 25 on appeal should be reversed.

Claim 26

Dependent claim 26 on appeal further specifies the organic group comprises $-Ar-((C_nH_{2n})CH{=}CH_2)_m$, wherein n is 0 to 20, m is 1 to 3 or $-Ar-((C_nH_{2n})SO_2CH{=}CH_2)_m$, where n is 0 to 20 and m is 1 to 3.

The Examiner referenced the passage at col. 4, line 25 to col. 5, line 22 of Boes et al. as showing the use of a variety of organic groups attached to the carbonaceous materials. However, that passage of Boes et al. does not appear to teach an organic group as recited in claim 26. Further, the arguments above with respect to claim 16 apply equally here.

In view of at least the above reasons, this rejection of claim 26 on appeal should be reversed.

Claim 27

Dependent claim 27 on appeal further specifies the organic group comprises at least one chiral ligand group.

The Examiner referenced the passage at col. 4, line 25 to col. 5, line 22 of Boes et al. as

showing the use of a variety of organic groups attached to the carbonaceous materials. However, that passage of Boes et al. does not appear to teach an organic group as recited in claim 27. Further, the arguments above with respect to claim 16 apply equally here.

In view of at least the above reasons, this rejection of claim 27 on appeal should be reversed.

Conclusion

For the reasons set forth above, the appellants submit that the claims presently pending in the above-captioned application meet all of the requirements of patentability. It is therefore respectfully requested that the Honorable Board reverse the Examiner and remand this application for issue.

Respectfully submitted,

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(10) Claims Appendix

1. A chromatography column comprising a column having a stationary phase and a mobile phase, wherein said stationary phase comprises carbonaceous material having attached at least one organic group, and wherein the carbonaceous material is particles having a size of from about 1 micron to about 500 microns.

2. The chromatography column of claim 1, wherein said organic group comprises at least one aromatic group directly attached onto the carbonaceous material.

3. The chromatography column of claim 1, wherein said organic group comprises at least one alkyl group directly attached onto the carbonaceous material.

4. The chromatography column of claim 1, further comprising a substance comprising chemical species to be separated in said column.

5. A separation device comprising a mobile phase and a stationary phase, wherein said stationary phase comprises carbonaceous material having attached at least one organic group, and wherein the carbonaceous material is particles having a size of from about 1 micron to about 500 microns.

6. A method for conducting separation of chemical species from a substance, wherein said method comprises passing said substance through a system containing a mobile phase and a stationary phase, wherein said stationary phase comprises carbonaceous material having attached at least one organic group, and wherein the carbonaceous material is particles having a size of from about 1 micron to about 500 microns.

7. The method of claim 6, wherein said separation is chromatography.

8. The method of claim 6, wherein said separation is size exclusion chromatography.

9. The method of claim 6, wherein said separation is chromatography by affinity wherein the chemical species in the substance have different affinities for the stationary phase.

10. The method of claim 6, wherein said separation is an adsorption-desorption chromatography.

16. The chromatography column of claim 1, wherein the organic group is a phenyl or naphthyl group having ionic or ionizable groups.

17. The chromatography column of claim 1, wherein the organic group comprises an amino acid or derivatized amino acid, cyclodextrin, immobilized protein, polypeptides, or combinations thereof.

18. The chromatography column of claim 1, wherein the organic group comprises a $-C_6F_5$ group, a trifluoromethyl-phenyl group, a bis-trifluorophenyl group, or combinations thereof.

19. The chromatography column of claim 1, wherein the organic group comprises $-Ar-(C_nH_{2n+1})_x$ group, wherein n is an integer of from about 1 to about 30 and x is an integer of from about 1 to about 3.

20. The chromatography column of claim 1, wherein the organic group comprises cyclodextrin attached through an alkyl group.

21. The chromatography column of claim 1, wherein the organic group comprises polyethylene glycol or methoxy-terminated polyethylene glycol or derivatized resins thereof.

22. The chromatography column of claim 1, wherein the organic group comprises $-Ar-((C_nH_{2n})COOX)_m$, wherein Ar is an aromatic group, n is 0 to 20, m is 1 to 3, and X is H, a cation, or an organic group.

23. The chromatography column of claim 1, wherein the organic group comprises $Ar-((C_nH_{2n})OH)_m$, wherein Ar is an aromatic group, n is 0 to 20, m is 1 to 3.

24. The chromatography column of claim 1, wherein the organic group comprises $-Ar-((C_nH_{2n})NH_2)_m$, wherein n is 0 to 20, m is 1 to 3, or its protonated form: $-Ar-((C_nH_{2n})NH_3X)_m$, wherein X is an ion, and Ar is an aromatic group.

25. The chromatography column of claim 1, wherein the organic group comprises $-Ar-((C_nH_{2n})CHNH_3^+COO^-)_m$ and the reaction products thereof with molecules containing functional groups terminated in $-NH_2$, -OH, or -COOH, wherein Ar is an aromatic group and n is 0 to 20.

26. The chromatography column of claim 1, wherein the organic group comprises $-Ar-((C_nH_{2n})CH{=}CH_2)_m$, wherein n is 0 to 20, m is 1 to 3 or $-Ar-((C_nH_{2n})SO_2CH{=}CH_2)_m$, where n is 0 to 20 and m is 1 to 3.

27. The chromatography column of claim 1, wherein the organic group comprises at least one chiral ligand group.

28. The chromatography column of claim 16, further comprising a second organic group attached on the carbonaceous material.

29. The chromatography column of claim 17, further comprising a second organic group attached on the carbonaceous material.

30. The chromatography column of claim 18, further comprising a second organic group attached on the carbonaceous material.

31. The chromatography column of claim 19, further comprising a second organic group attached on the carbonaceous material.

32. The chromatography column of claim 20, further comprising a second organic group attached on the carbonaceous material.

33. The chromatography column of claim 21, further comprising a second organic group attached on the carbonaceous material.

34. The chromatography column of claim 22, further comprising a second organic group attached on the carbonaceous material.

35. The chromatography column of claim 23, further comprising a second organic group attached on the carbonaceous material.

36. The chromatography column of claim 24, further comprising a second organic group attached on the carbonaceous material.

37. The chromatography column of claim 25, further comprising a second organic group attached on the carbonaceous material.

38. The chromatography column of claim 26, further comprising a second organic group attached on the carbonaceous material.

39. The chromatography column of claim 28, wherein said second organic group has a shorter chain length or less steric hindrance than said organic group.

40. The chromatography column of claim 29, wherein said second organic group has a shorter chain length or less steric hindrance than said organic group.

41. The chromatography column of claim 30, wherein said second organic group has a shorter chain length or less steric hindrance than said organic group.

42. The chromatography column of claim 31, wherein said second organic group has a shorter chain length or less steric hindrance than said organic group.

43. The chromatography column of claim 32, wherein said second organic group has a shorter chain length or less steric hindrance than said organic group.

44. The chromatography column of claim 33, wherein said second organic group has a shorter chain length or less steric hindrance than said organic group.

45. The chromatography column of claim 34, wherein said second organic group has a shorter chain length or less steric hindrance than said organic group.

46. The chromatography column of claim 35, wherein said second organic group has a shorter chain length or less steric hindrance than said organic group.

47. The chromatography column of claim 36, wherein said second organic group has a shorter chain length or less steric hindrance than said organic group.

48. The chromatography column of claim 37, wherein said second organic group has a shorter chain length or less steric hindrance than said organic group.

49. The chromatography column of claim 38, wherein said second organic group has a shorter chain length or less steric hindrance than said organic group.

(11) Evidence Appendix

None.

(12) Related Proceedings Appendix

None.